Focused Cavity Aerosol Spectrometer II (FCAS II)

Instrument: Focused Cavity Aerosol Spectrometer II (FCAS II)
Principal Investigators: J. Michael Reeves
Co-Investigator: James C. Wilson
Organization: Department of Engineering
University of Denver
Denver, CO 80208-0177

Measurement Description:

Instrument Function
The FCAS II sizes particles in the approximate diameter range from 0.09 to 2 microns. Particles are drawn from the free stream with a near-isokinetic inlet and transported to the instrument. They then pass through a laser beam, and the light scattered by individual particles is measured (Fig. 1). Particle size is related to the intensity of the scattered light. The data reduction for the FCAS II takes into account the water that is evaporated from the particle during sampling and the effects of anisokinetic sampling [Jonsson *et al.,* 1995].

1. Data Products
   The FCAS instruments have provided accurate measurements of aerosol size distributions throughout the evolution of the volcanic cloud produced by the eruption of Mt. Pinatubo [Wilson *et al.,* 1993]. Near coincidences between FCAS II and SAGE II observations show good agreement between optical extinctions calculated from FCAS size distributions and those measured by SAGE II (Fig. 2).

Accuracy:	The instrument is calibrated with monodisperse aerosol carrying a single charge. Particle number agrees with an electrometer standard to within 10%, and monodisperse diameter is recovered within 5%. Sampling errors may increase the uncertainty, but a variety of comparisons indicate that total uncertainties in aerosol surface are near 30% [Jonsson *et al.,* 1995].
Precision:	The precision equals $1/\sqrt{N}$ when N particles are counted. In many instances the precision on concentration measurements may reach 7% for 0.1 Hz data. If better precision is desired, it is necessary only to accumulate over longer time intervals.
Response Time:	Data are acquired at 1 Hz, but response time depends upon the precision required to detect the change in question. Measurements of the stratospheric background aerosol are generally reported with 10 or 30-second resolution, while higher particle concentrations can be processed with 1-second resolution.

Weight: Approximately 55 lbs.

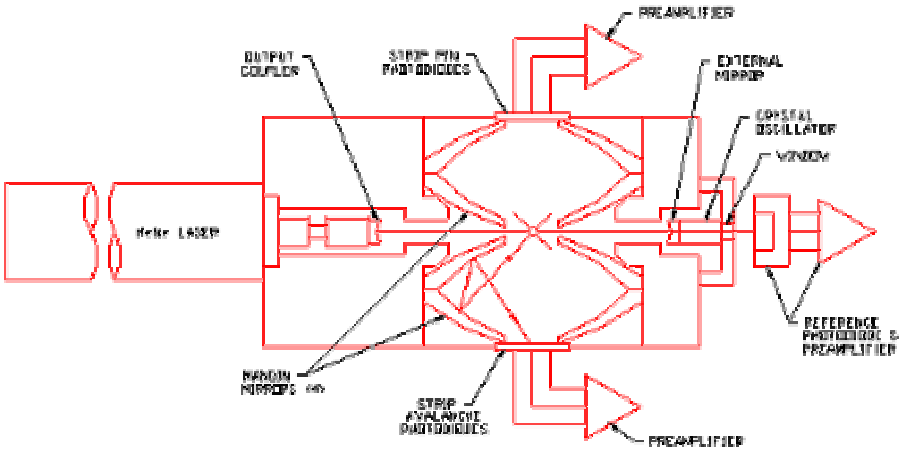

Figure 1. Diagram of the FCAS II optical system. A converging lens on the output of the laser and an external converging mirror form a focusing cavity that permits detection of particles as small as 90 nm.

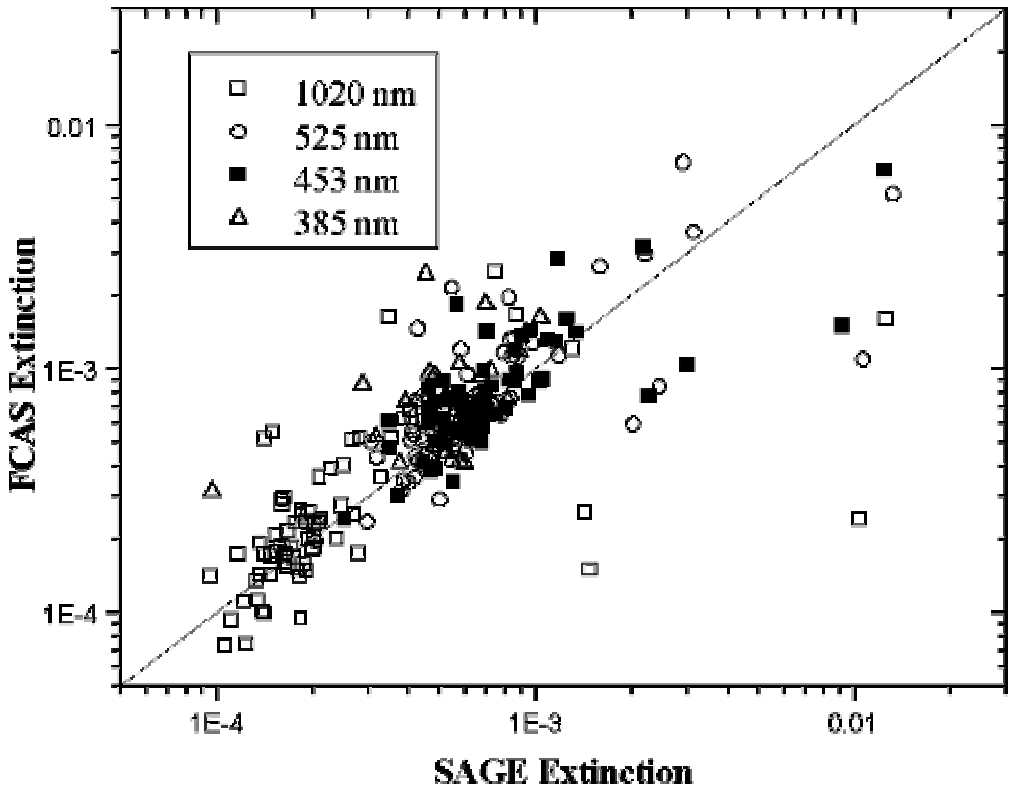

Figure 2. Extinction at the SAGE wavelengths, calculated from size distributions measured with the FCAS II, plotted against extinctions measured by SAGE II. Comparison data were chosen for near coincidence in time and space. Median discrepancy is about 25%.

References:

Jonsson, H. H., J. C. Wilson, C. A. Brock, R. G. Knollenberg, R. Newton, J. E. Dye, D. Baumgardner, S. Borrmann, G. V. Ferry, R. Pueschel, D. C. Woods, and M. C. Pitts, Performance of a focused cavity aerosol spectrometer for measurements in the stratosphere of particle size in the 0.06-2.0-μm-diameter range, *J. Atmos. Ocean. Tech., 12,* 115-129, 1995.

Wilson, J. C., H. H. Jonsson, C. A. Brock, D. W. Toohey, L. M. Avalone, D. Baumgardner, J. E. Dye, L. R. Poole, D. C. Woods, R. J. DeCoursey, M. Osborne, M. C. Pitts, K. K. Kelly, K. R. Chan, G. V. Ferry, M. Loewenstein, J. R. Podolske, and S. Weaver, In situ observations of aerosol and chlorine monoxide after the 1991 eruption of Mount Pinatubo: effect of reactions on sulfate aerosol, *Science, 271,* 1140-1143, 1993.